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54 **A novel physical form of gluten, method for its manufacture and its use.**

57 **A process for producing a novel physical form of gluten that can be utilized as a self-binder for meat-like products, thereby excluding the need of, for example, egg albumen. The novel physical form contains an inert material bound within its matrix and is characterized by its net-like fibrous structure, which fibres preferably have a diameter of less than 2 mm and a viscosity of at least 50.000 cps.**

The novel physical form of gluten is obtained by agitating vital wheat gluten with a reducing agent at a temperature below 70°C and incorporating during said agitation the solid inert material having a particle size below 5 cm diameter. A preferred type of said inert material is textured vegetable protein.

The product obtained according to the invention can be successfully utilized in meat industry, enhancing the binding properties of the meat and improving its texture as an extender.

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The present invention relates to a gluten-based self-binder. More particularly the invention relates to a novel physical form of gluten to be utilized as a self-binder for meat-like products.

Gluten occurs in nature in combination with carbohydrate,  
5 lipids and minerals. Vital wheat gluten, sometimes referred to herein for convenience simply as gluten, is a concentrated natural protein in the form of a light tan powder having a bland taste and aroma. Gluten is known to consist mainly of gliadin (prolamin) and glutenin (glutelin) which are the principal cereal  
10 proteins. It is well-known in the art the method of gluten separation from wheat flour by washing. The gliadin sticks to the glutenin and prevents it from being washed out during washing. Up to now most of the gluten is utilized in bakery industry.

It has already been suggested to utilize gluten as a basic  
15 material in various protein foods of vegetable derivation to achieve a texture which simulates that of meat and meat products. There are many references describing various methods for processing gluten and manufacturing diversified products thereof. In accordance with U.S. Patent Number 3,290,152, a high protein uniform synthetic  
20 food product is obtained from a finely divided dehydrated vital wheat gluten and water, by a simultaneous rapid cutting of the mixture at high speed to keep the water and vital wheat gluten particles in intimate mixture. In accordance with U.S. Patent Number 3,170,310 a fibrous high protein food product is obtained  
25 by blending a composition comprising wet gluten with defatted oil seed flour and oven setting the resulting composition. The composition contains preferably also a heat coagulable protein such as egg albumen. In accordance with the Canadian Patent Number 848,913 meat-like wheat gluten products are obtained from

gluten, alkali metal salt to adjust the pH to a range of 7 to 10, a reducing agent, water and subsequently heated to gelatinize the gluten. In order to render a fibrous texture to the gluten, known to be desirable to meat-like products, the gluten is gelatinized and elongated at the same time by its heating in boiling water. 5 Gums with high molecular weight are claimed to be required in the boiling water in order to transform the flakes in a fibrous texture. In accordance with U.S. Patent Number 3,840,515, the aestatic properties of grain protein are upgraded in order to 10 render them suitable for incorporation into animal protein in foods i.e. meat.

Meat-like products are generally made from the following types of main ingredients: (1) texture ingredients; (2) fat and emulsifiers; (3) spices and flavour and (4) binders. The binder 15 commonly used for meat analog products is egg albumen, sometimes with the addition of vegetable gums. Both egg albumen and vegetable gums are among the most expensive ingredients in the formulation and consist a major part of the meat-like product costs.

We have now discovered a process for producing a physical 20 form of gluten. This novel physical form of gluten has self-binding properties, and it can be utilized in meat-like products.

Thus, the present invention consists in a process for producing a particular physical form of gluten, having a net-like fibrous structure (the fibres preferably have a diameter of less than 25 2mm), a viscosity of at least 50,000 cps, and self-binding property which comprises: agitating vital wheat gluten with a reducing agent at a temperature below 70°C; and, during this agitation, incorporating a solid inert material having particles less than 5cm in diameter, thereby binding the material within the matrix 30 of the gluten.

The present invention also consists in a method of producing a meat-like product, by incorporating a gluten produced by the process of the invention in a meat processing operation. The gluten can act as binder and extender.

The novel physical form of gluten obtained according to the present invention has true binder-like properties and thus is particularly useful for many purposes. Fine powdered gluten, is known to be extremely hydrophilic; upon initial wetting, it hydrates, becoming a sticky elastic and tenacious rubber mass, giving the impression to possess adhesive like properties. However, it does not possess binding properties similar to those of the novel physical form obtained according to the present invention.

During the first step of agitation in the presence of a reducing agent, the gluten particles soften moderately and a net-like fibrous structure is gradually formed. This fibrous structure is subsequently stabilized by the incorporation of the solid inert material. The mechanism which will explain how the stabilization of the net-like fibrous structure occurs is not yet fully elucidated. As known the intramolecular bonds in gluten are complex and probably many forces are in action besides hydrogen bonding and the disulphide groups. It may be assumed that after a prior reduction of the gluten, which has been found to be absolutely necessary in order to obtain the new gluten form, the incorporation of the inert material (e.g. textured vegetable protein) to the incipient fibrous form of gluten, contributes to the interaction which occurs between the glutenin and gliadin as a result of the difference in the electric charge, thus causing the stabilization of the net-like fibrous structure.

According to a preferred embodiment of the present invention, the solid inert material added during agitation in the second step is textured vegetable protein. The novel physical form of gluten thus formed has been found to possess outstanding binding properties for the ingredients in a meat-like products, being thus able to replace the expensive egg albumen. Furthermore, the presence of gluten improves the "meaty" structure of the final product. As known in the art, gluten has a particular advantage when present together with soya derivatives thus imparting a protein efficiency ratio which is very close to that of pure meat. When utilized in meat-like products, additional ingredients such as colouring agents, flavourings reagents and fat are generally

incorporated. The artificial meat obtained can be used as such, being a high quality meat analog, or as a raw material for manufacturing every kind of processed meat such as sausage, hamburger, meat spread and corned beef. When used without any meat additive, it has a particular advantage being completely "pareve" consisting of pure vegetable protein food which closely duplicates the nutrition, flavour, texture and appearance of meat. It can be precisely formulated to provide the required nutritional levels of protein, fat and carbohydrates.

Although the novel physical form of gluten obtained according to the present invention can replace even completely the relatively expensive egg albumen, there are cases when egg albumen may also be added but at lower levels to retain the "meaty" bounded texture of the meat-like product, especially after being heated. The presence of egg albumen might also be required when high ratio of texturised vegetable protein (e.g. 10 parts) to gluten (e.g. 1 part) are utilized during the preparation of the new physical form of gluten. Generally the ratio between the gluten and the textured vegetable protein may be varied in a broad range being generally between 1 part gluten to 0.1 to 10 parts of textured vegetable protein and preferably between 1 part gluten to 4 parts textured vegetable protein. Beyond these ratios, the binding effect of the novel physical form of gluten is far poorer.

As would appear from the Examples given in this specification, egg albumen may be completely omitted when the ratio of rehydrated wheat gluten to the inert material is 6 : 1. The following Table 1 summarizes the ratios utilized in the Examples versus the egg albumen added:

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TABLE 1

	<u>Rehydrated wheat gluten</u>	<u>Inert material (textured soy)</u>	<u>Egg albumen required for binding</u>
	1	6	0.35
5	2	5	0.25
	6	1	0

In addition to the property of the novel physical form of gluten as self-binder in analog-meat products, it has been found that it can successfully be utilized as extender for meat.

10 Meat by itself has also some binding property for the other ingredients normally present, whereas textured vegetable protein is completely devoid of this property. Thus the novel physical form according to the present invention, when utilized in meat industry will serve a two-fold purpose: enhancing the binding properties of

15 the meat and extending the meat thus improving its texture.

According to another embodiment of the present invention, the binding properties of the novel physical form of gluten can be utilized in the manufacturing of various products such as: paper, adhesives, puddings, jelly, encapsulates and pellets.

20 Other inert materials instead of textured vegetable protein may be utilized, provided that their particle size is not above 5 cm and is preferably below 3 cm. It is also possible to start with larger particles size, their comminution to the desired size occurring during the vigorous agitation. Examples of such

25 solid materials are: cellulosic materials, minerals and micronutrients.

The entire process for the manufacture of the novel physical form of gluten is very simple. Fresh gluten or rehydrated gluten is thoroughly mixed with a solid or an aqueous solution of a reducing reagent. Examples of such reducing agents are: tocopherol, ascorbic acid, butylated hydroxyanisole, butylated hydroxytoluene, sodium sulphite, sodium bisulphite etc. An incipient fibrous structure can be observed but this completely collapses when the mixer is stopped. While continuing the vigorous agitation, a textured vegetable protein as inert material is added and the novel physical form of gluten is achieved. A typical example of textured vegetable is hydrated extruded soy flour.

While the invention has been described in connection with specific embodiments thereof, it will be understood that it is capable of further modification and this patent is intended to cover any variation, uses, or adaptation of the invention, following in general the principle of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains and as may be applied to the essential features herein before set forth and as fall within the scope of the invention. The following examples are therefore given only for illustrating the invention without being limiting the boundary of the invention.

#### EXAMPLE 1

An amount of 600 g rehydrated wheat gluten was mixed with 0.3 g of sodium sulphite. After ten minutes of vigorous agitation an amount of 100 g of rehydrated textured soy (particle size between 1 to 2 cm) was added while the agitation was continued. Additional ingredients added were: 10 g of vegetable oil, spices and flavour. The final mix was prepared as meat-like hamburger in which all ingredients were bounded in an homogeneous mass, although no egg albumen was present.

#### EXAMPLE 2

An amount of 100 g of rehydrated wheat gluten was mixed

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with 0.01 of ascorbic acid. After about ten minutes of continuous mixing an amount of 600 g of rehydrated textured soy flour was added while the mixing continued. The following ingredients were further incorporated: 10 g of vegetable oil, 35 g of egg albumen, spices, flavour and caramel. The final mix was prepared as meat-like steak in which all ingredients were bounded in an homogeneous mass being of an excellent quality as tested by a panel group.

EXAMPLE 3

10 The same procedure as described in Example 2 repeated with the exception that 200 g of rehydrated wheat gluten were mixed with 0.1 g of sodium sulphite and 500 g of rehydrated textured vegetable protein. The same amount of flavouring agents, spices and fat were added the difference being the requirement of only  
15 25 g of egg albumen in order to obtain the same bounded homogeneous mess as in Example 2.

EXAMPLE 4

This examples illustrated the utilization of the new physical form of gluten as meat extender. An amount of 300 g of rehydrated  
20 gluten was mixed with 0.2 g of sodphum sulfite and after about ten minutes of continuous agitation, 400 g of hydrated textured vegetable protein were added. It was found that up to 3 parts of said gluten form to 1 part meat can be successfully utilized (as meat extender); without impairing the binding or texture  
25 properties of the mass obtained.



## CLAIMS:

1. A process for producing a gluten having a net-like fibrous structure, a viscosity of at least 50,00 cps, and self-binding properties, which comprises: agitating vital wheat gluten with a reducing agent at a temperature below 70°C; and, during this agitation, incorporating a solid inert material having particles less than 5 cm in diameter, thereby binding the material within the matrix of the gluten.
2. A process according to Claim 1, in which the reducing agent is tocopherol, ascorbic acid, sodium sulphite or sodium bisulphite.
3. A process according to Claim 1 or Claim 2, in which the solid inert material is textured vegetable protein.
4. A process according to Claim 3, in which the textured vegetable protein is rehydrated extruded soya.
5. A process according to any one of the preceding Claims, in which 1 part of wheat gluten is incorporated with from 0.1 to 10 parts of solid inert material.
6. A process according to Claim 1, substantially as herein described with reference to the foregoing examples.
7. A gluten when produced by a process according to any one of the preceding Claims.
8. A gluten according to Claim 7, in which the fibres comprising the net-like fibrous structure have a diameter of less than 2 mm.
9. A method of producing a meat-like product in which a gluten according to Claim 8 is used as a binder.
10. A method according to Claim 9, in which one or more of colouring agents, spices and fats are ingredients of the meat-like product.

11. A method according to Claim 9, or Claim 10, in which a small amount of a common binder is used.
12. A method according to any one of Claims 9, 10 and 11, in which a gluten according to Claim 8 is used in the processing of sausage meat, hamburger meat, meat spread or corned beef.
13. A method according to any one of Claims 9 to 12, in which a gluten according to Claim 6 is used as a binder and extender for meat.
14. A method according to Claim 9, substantially as herein described with reference to any one of the foregoing examples.
15. A meat-like product when produced by a product according to any one of Claims 9 to 14.

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## EUROPEAN SEARCH REPORT

Application number

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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	<u>US - A - 4 000 331</u> (KENJI TANAKA) * Claims; column 1, lines 39 to 42 and 50 to 56; column 2, lines 1 to 6 and 46 to 49 * --	1-3,5-10,13-15	A 23 J 3/00 A 23 L 1/31 C 07 G 7/00
X	<u>DE - A - 1 692 735</u> (NISSHIN FLOUR MILLING) * Claims 1,5,7,10,11; page 7, lines 1 to 6; page 11, lines 4 to 16; examples * --	1,2,6-15	TECHNICAL FIELDS SEARCHED (Int. Cl.) A 23 J 3/00 A 23 L 1/31
D	<u>US - A - 3 290 152</u> (W.E. HARTMAN) * Claims; column 2, line 60 to column 3, line 3; column 5, lines 27 to 35 and 42 to 65; column 5, line 71 to column 6, line 2; example II * -- <u>GB - A - 1 345 168</u> (BRITISH SOYA PRODUCTS) * Claims; page 1, lines 71 to 75 and 81 to 86; page 2, lines 13 to 38 * --	1-15  1,5,9-12,15	CATEGORY OF CITED DOCUMENTS X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
A	<u>US - A - 3 197 310</u> (N.A. KJELSON)		
A	<u>US - A - 3 102 031</u> (R.V. MacALLISTER et al.)		
P	CHEMICAL ABSTRACTS, vol.89, no.13, published 25 September 1978 Columbus, Ohio, USA NAWATA, JORITAKA: "Preparation of foods containing gluten fibers", see page 650 (and 651), column 2, abstract 106235h. ./	1,2,5,7-11,13-15	&: member of the same patent family, corresponding document
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 25-5-1979	Examiner NUSS

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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. <sup>3</sup> )
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	& JP - A - 78 44651 * Abstract *  -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl. <sup>3</sup> )